

Carbon Sequestration – Public Meeting



*Programmatic Environmental
Impact Statement
Public Meeting*

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Office of Fossil Energy



Carbon Sequestration Program Overview

- **What is Carbon Sequestration?**
- **The Fossil Energy Situation**
- **Greenhouse Gas Implications**
- **Pathways to Greenhouse Gas Stabilization**
- **Sequestration Program Overview**
- **Program Requirements & Structure**
- **Regional Partnerships**
- **FutureGen**
- **Sources of Information**



What is Carbon Sequestration?

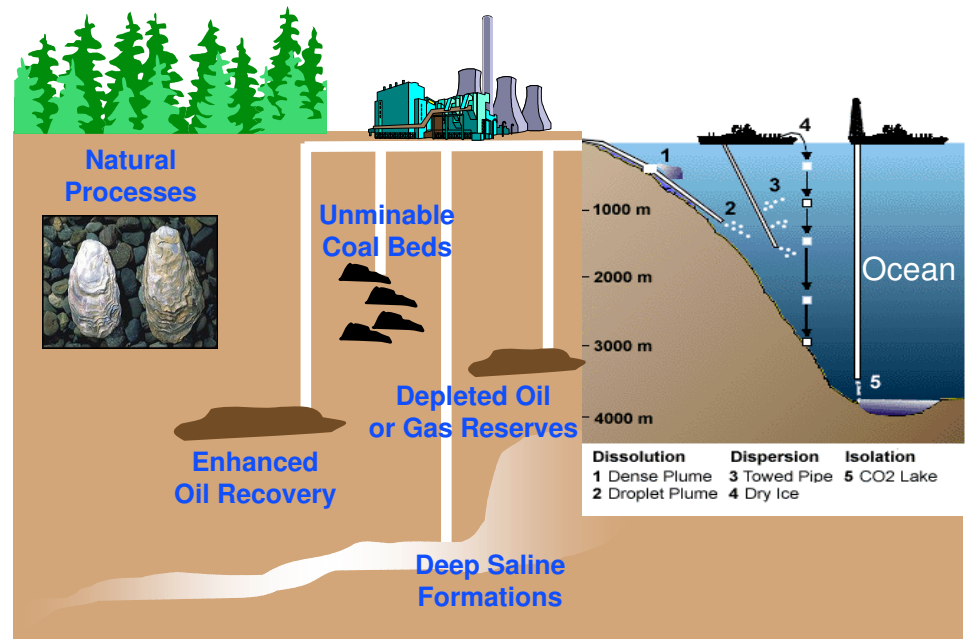
Capture and storage of CO₂ and other Greenhouse Gases that would otherwise be emitted to the atmosphere

Capture can occur:

- At the point of emission
- When absorbed from air by plants and minerals

Storage locations include:

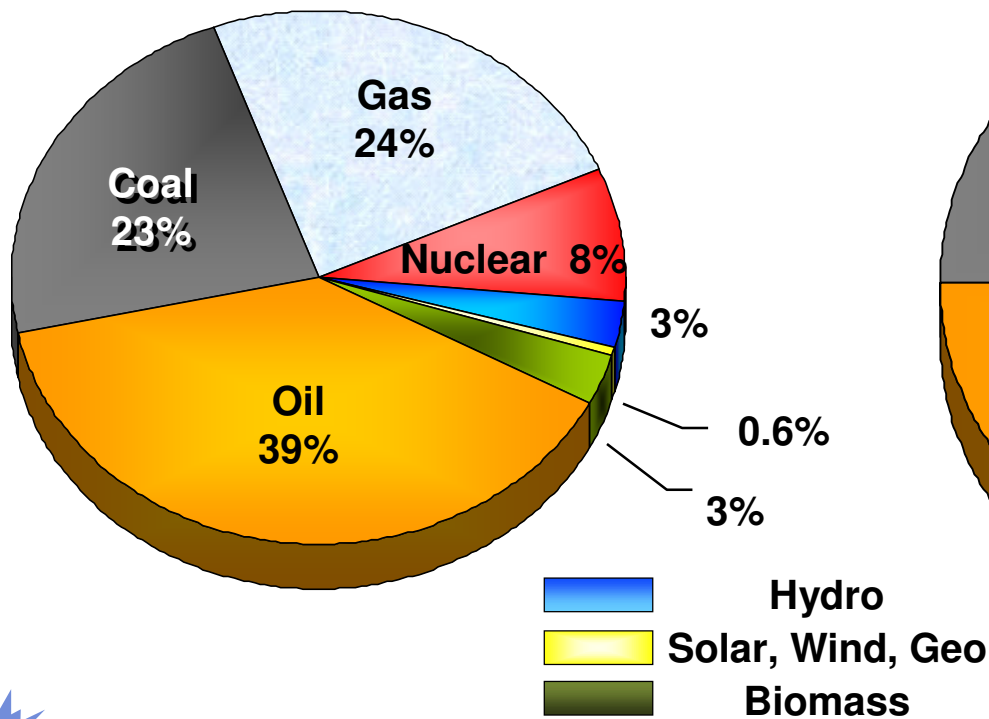
- Underground reservoirs
- Trees, plants, soils, or algae
- Converted to solid materials
- Dissolved in deep oceans



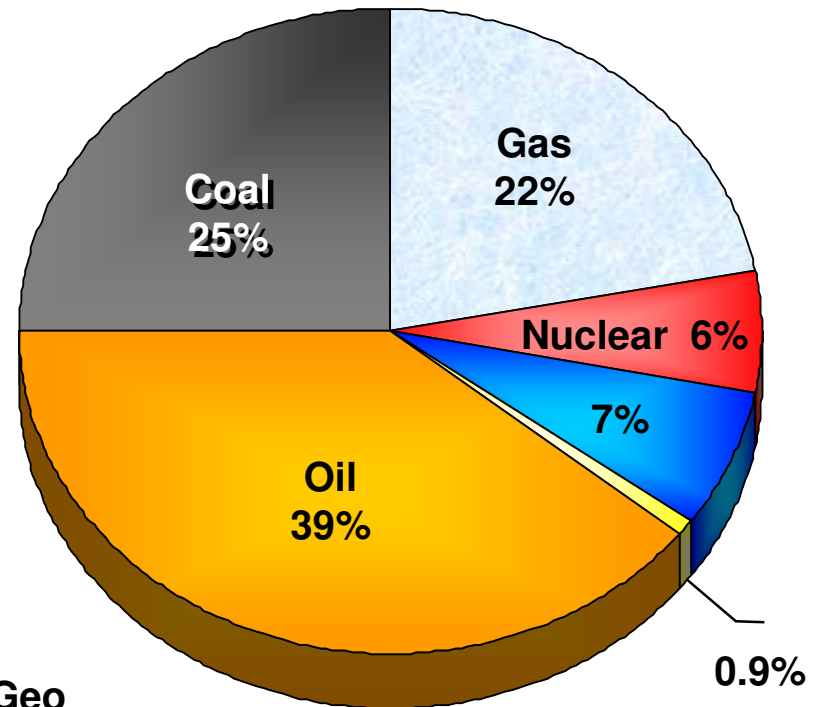
Fossil Fuels

World's Dominant Energy Source

United States
98 QBTu/yr; 86 % Fossil Energy



World
382 Quads/yr; 86 % Fossil Energy



World Data from EIA96. Does not include non-grid-connected biomass.
U.S. Data from Table 2 of EIA REA 97 & AEO 2004

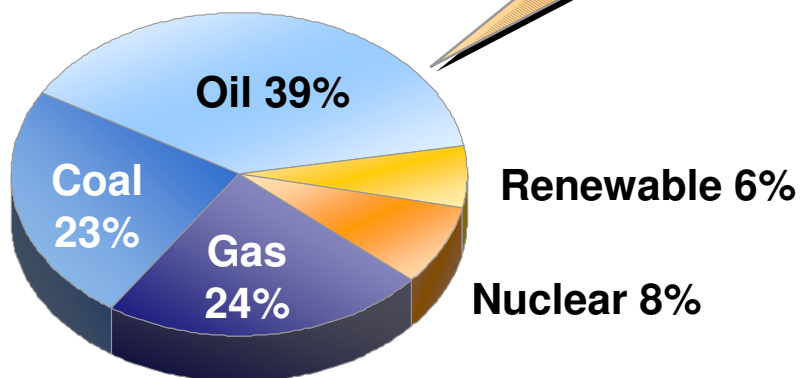


Fossil Energy - America's Energy Foundation

2002

98 Quads

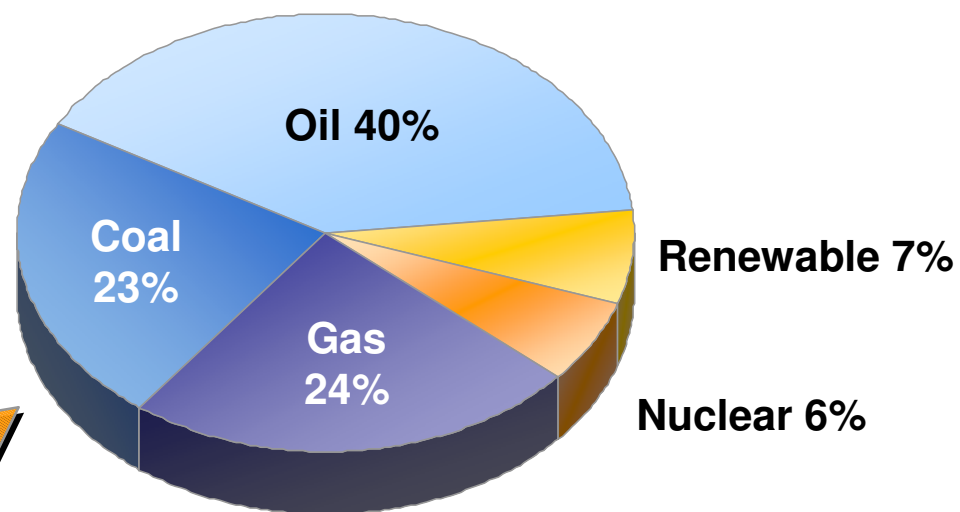
**Fossil fuels provide
86% of energy**



2025

136 Quads

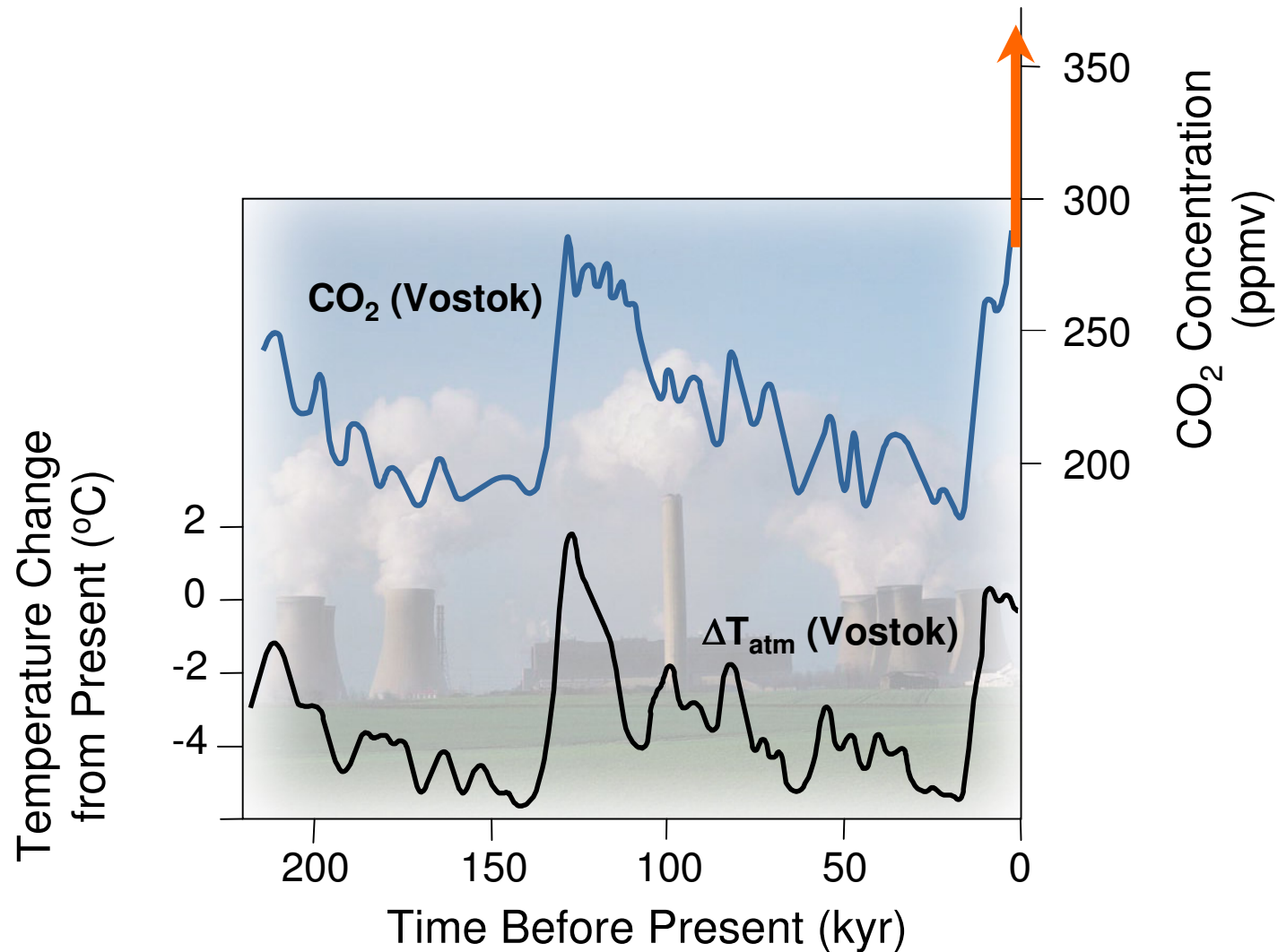
**By 2020, reliance on
fossil fuels remains
stable at 87%**



Source: AEO 2004

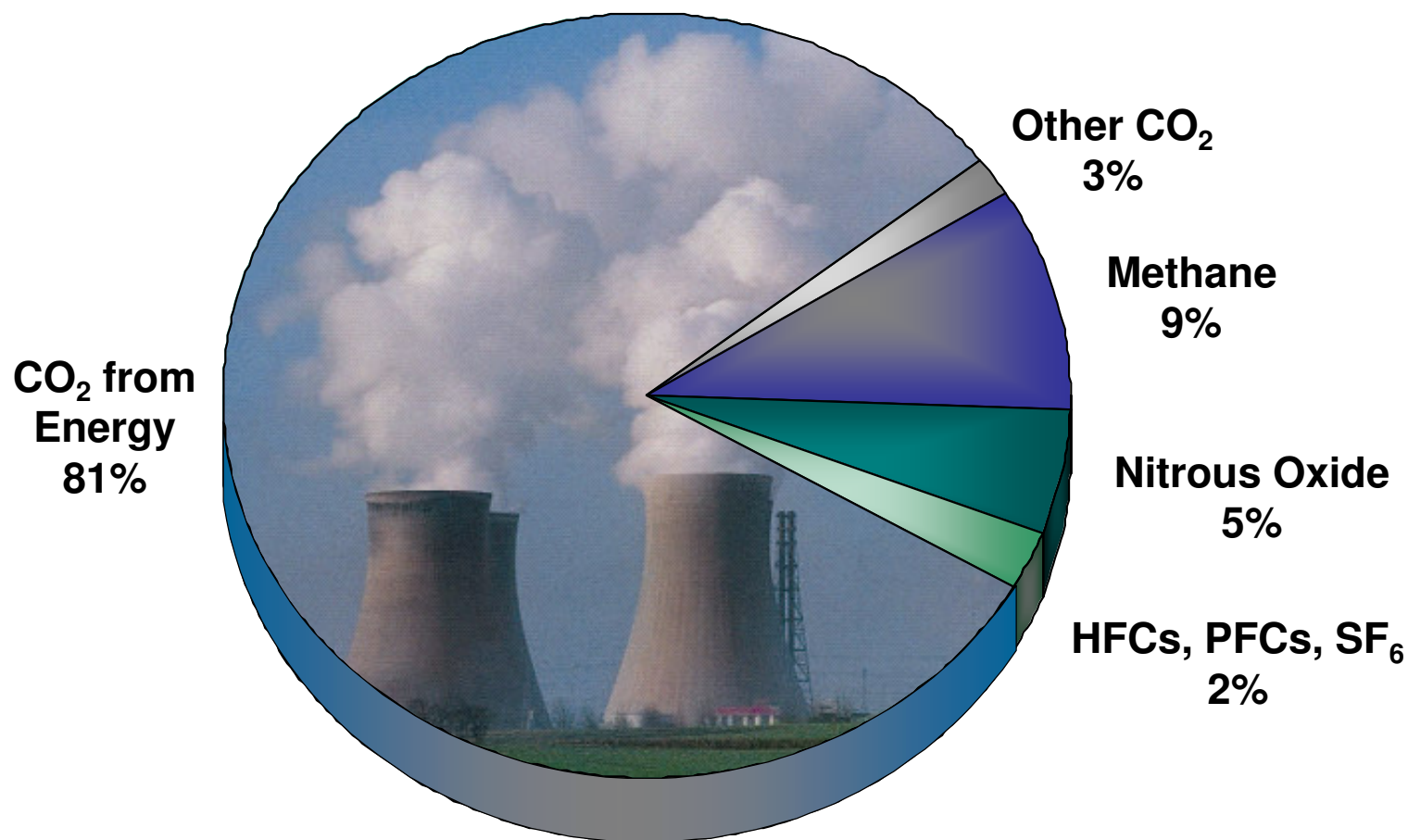
CO₂ Concentrations On The Rise

(~280 ppm to 370 ppm over last 100 years)



CO₂ & CH₄ - The Primary GHG Contributors

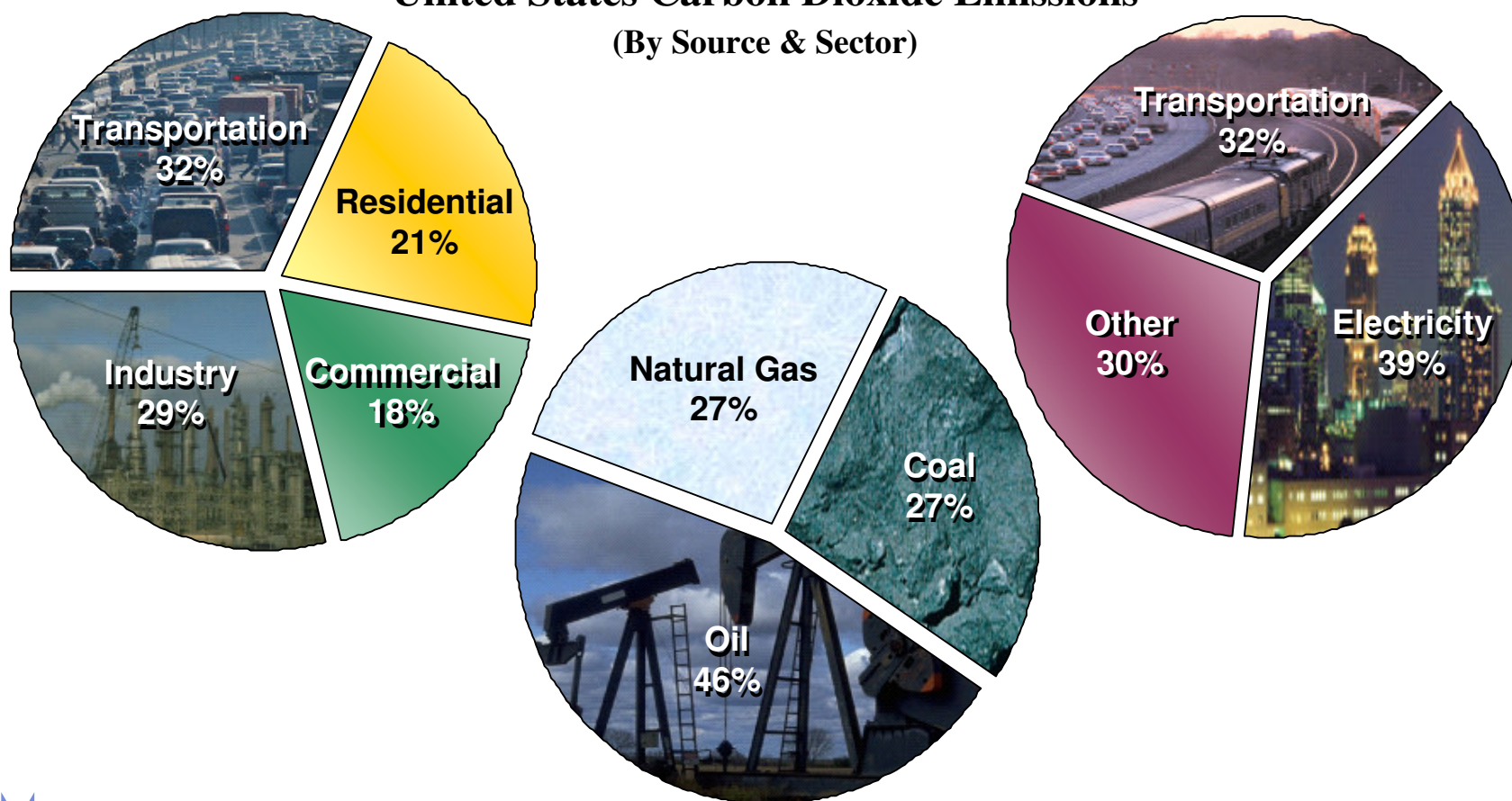
United States Greenhouse Gas Emissions
(Equivalent Global Warming Basis)



"EIA Emissions of Greenhouse Gases in the U.S.: 2000"

All Fossil Fuels & Energy Sectors Contribute CO₂ Emissions

United States Carbon Dioxide Emissions
(By Source & Sector)



Technological Carbon Management Options

Reduce Carbon Intensity

- Renewable Sources
- Nuclear
- Fuel Switching

Improve Efficiency

- Demand Side
- Supply Side

Sequester Carbon

- Capture & Store
- Enhance Natural Sinks

All options needed to:

- Affordably meet energy demand
- Address environmental objectives



Presidential Direction

Current Drivers for Carbon Sequestration

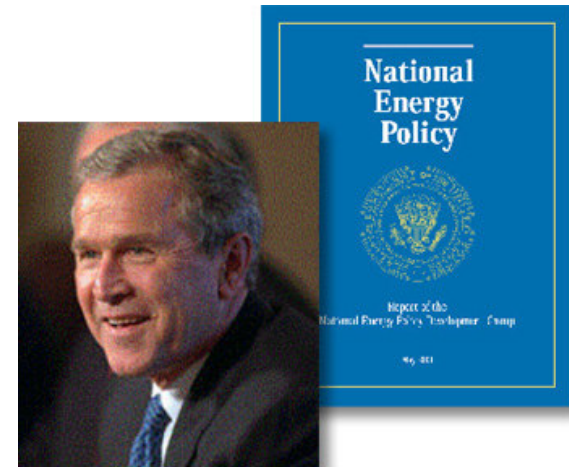
National Climate Change Technology Initiative June 11, 2001

- Third option for global climate change
- Enables continued use of domestic energy resources and infrastructure
- Geologic formations have potential for essentially unlimited storage capacity
- Demonstrated industry interest, participation, and cost-sharing in public/private partnerships
- “We all believe technology offers great promise to significantly reduce emissions -- especially carbon capture, storage and sequestration technologies.”



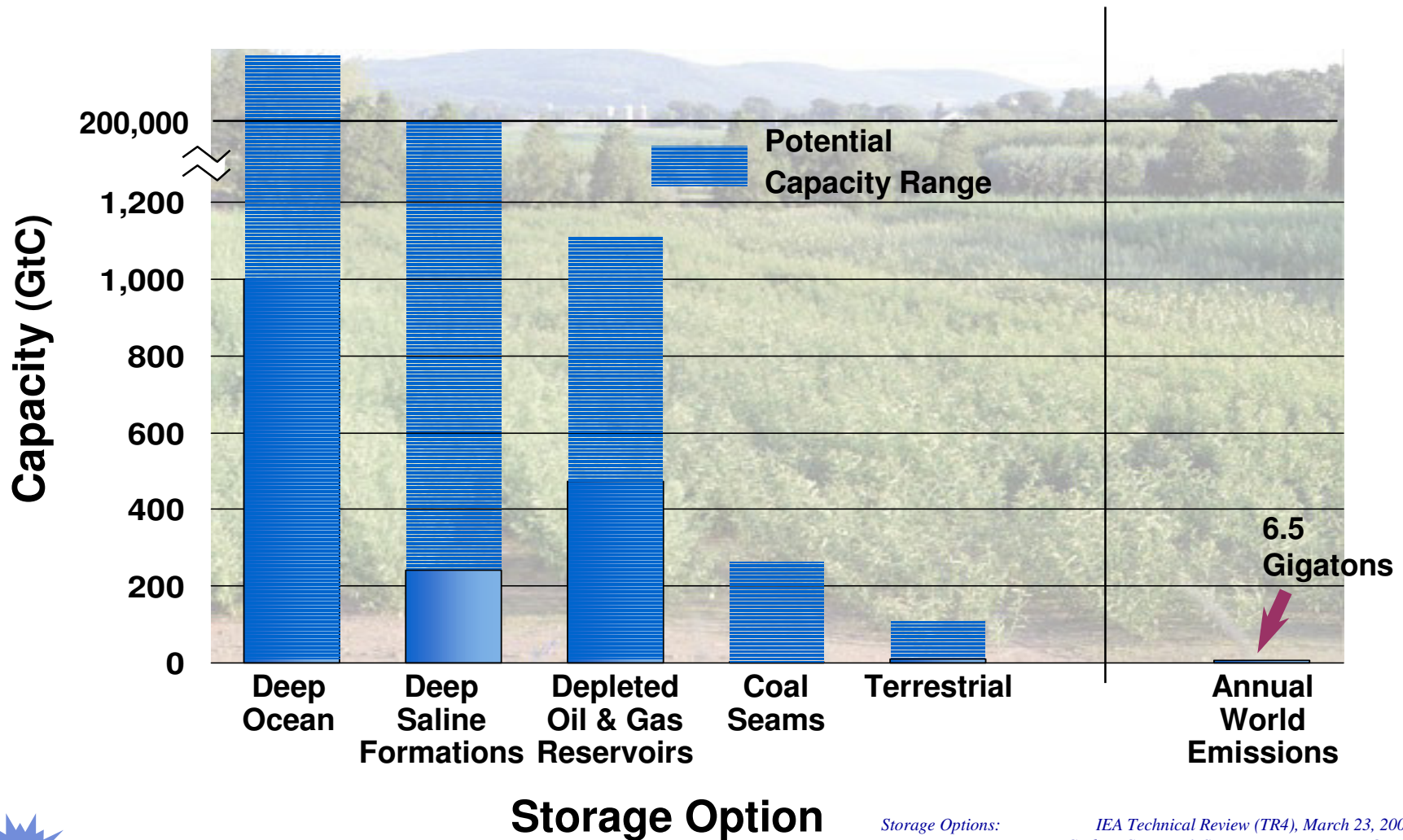
Global Climate Change Initiative February 14, 2002

- Sustain economic growth
- Reduce GHG intensity by 18% in next 10 years
- Reevaluate science & path in 2012



White House photo: Paul Morse

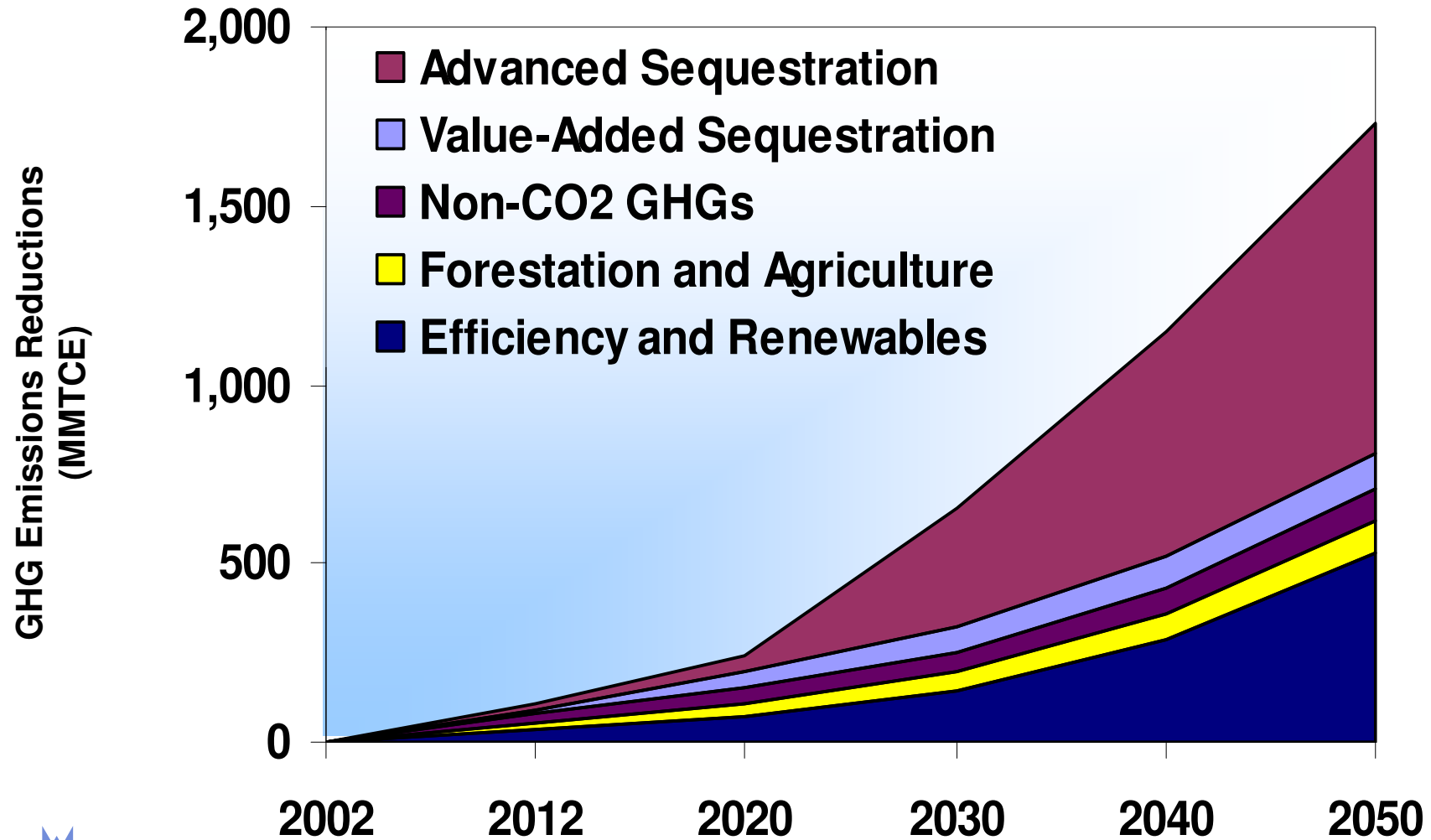
Large Potential Worldwide Storage Capacity



Storage Options: IEA Technical Review (TR4), March 23, 2004
Carbon Capture & Sequestration Program @MIT
World Emissions: DOE/EIA, International Energy Outlook 2003, Table A10

Sequestration = Stabilization

Plausible Scenario to Stop GHG Emissions Growth

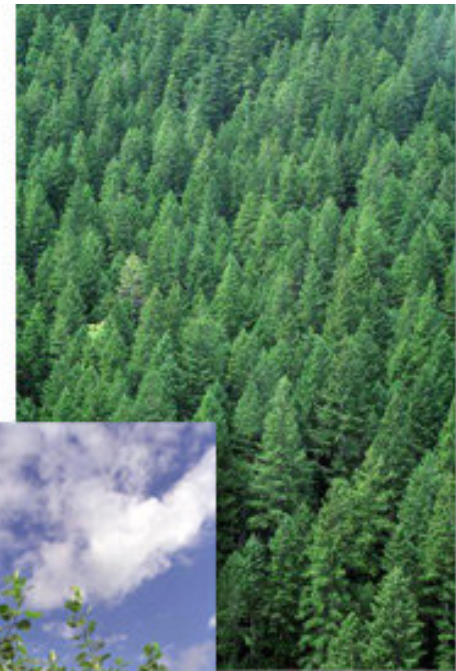


*EIA Annual Energy Outlook 2002; EPA special studies;
DOE/FE/NETL Sequestration Benefits Model*

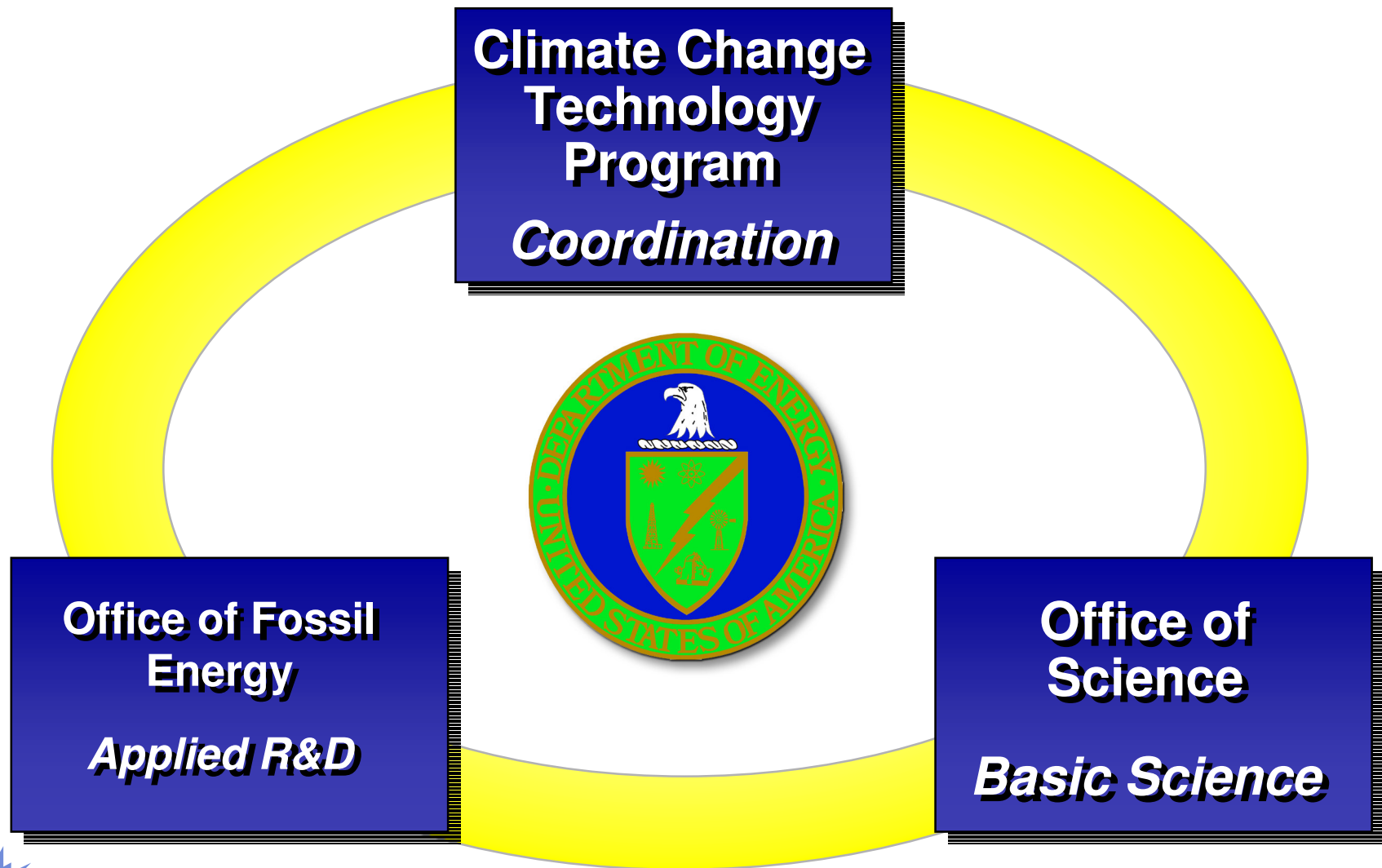


Requirements for Sequestration

- **Environmentally acceptable**
 - No legacy for future generations
 - Respect existing ecosystems
- **Safe**
 - No sudden large-scale CO₂ discharges
- **Verifiable**
 - Ability to verify amount of CO₂ sequestered
- **Economically viable**



Sequestration at DOE



Agencies Conducting Sequestration-Related Research

USGS

Geologic sequestration research

NASA

Space-based studies of earth as integrated system

EPA

Non-CO₂ Greenhouse Gas mitigation

OSM

Carbon sequestration on abandoned mine sites

NOAA

Atmospheric and oceanic global observations



USAID

Tropical reforestation in developing countries

NSF

Science of CO₂ and N₂ cycles in oceans

USDA

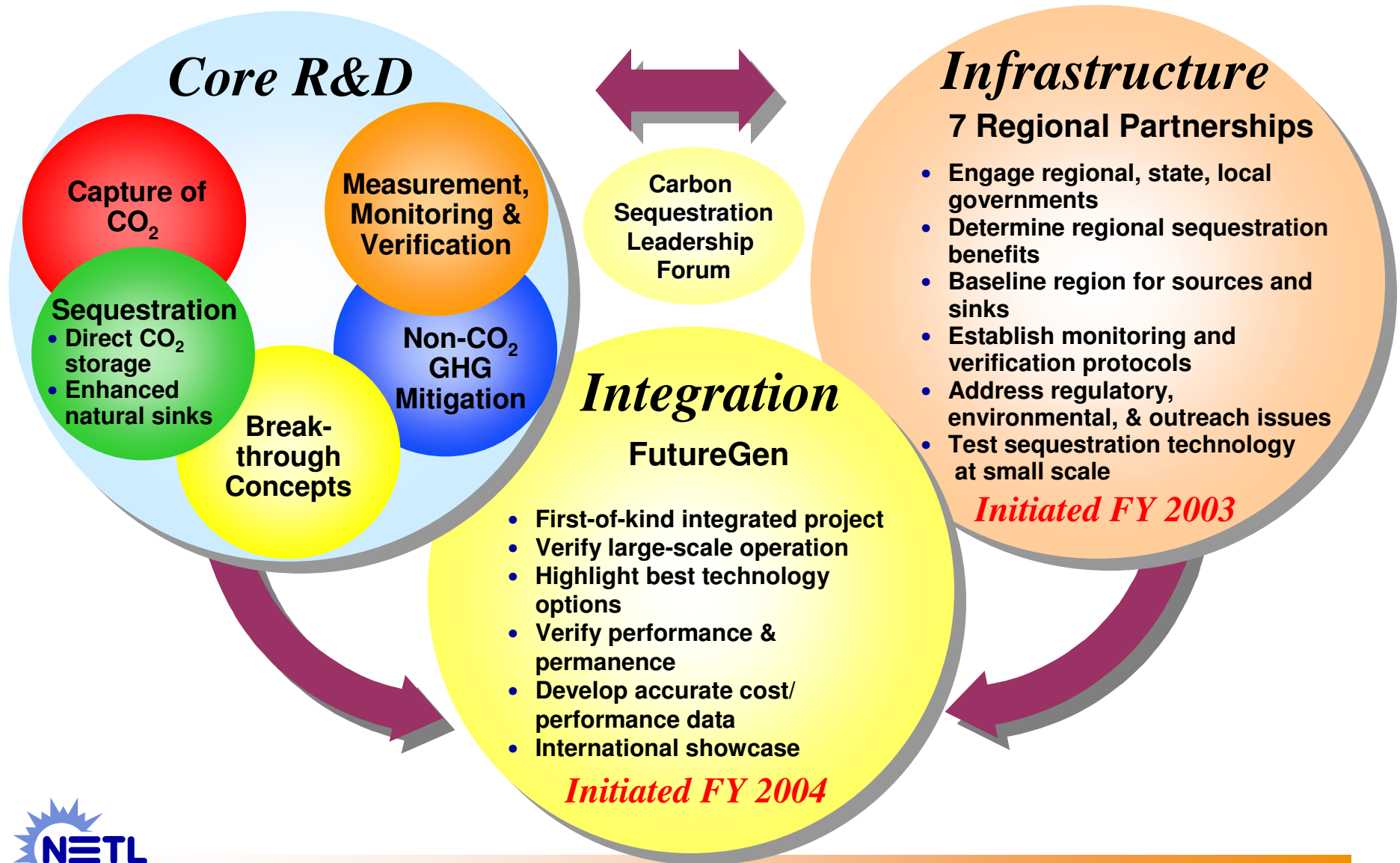
Terrestrial sequestration, soil carbon database, sequestration models

U.S. Dept. of State

Facilitate International collaboration and activities

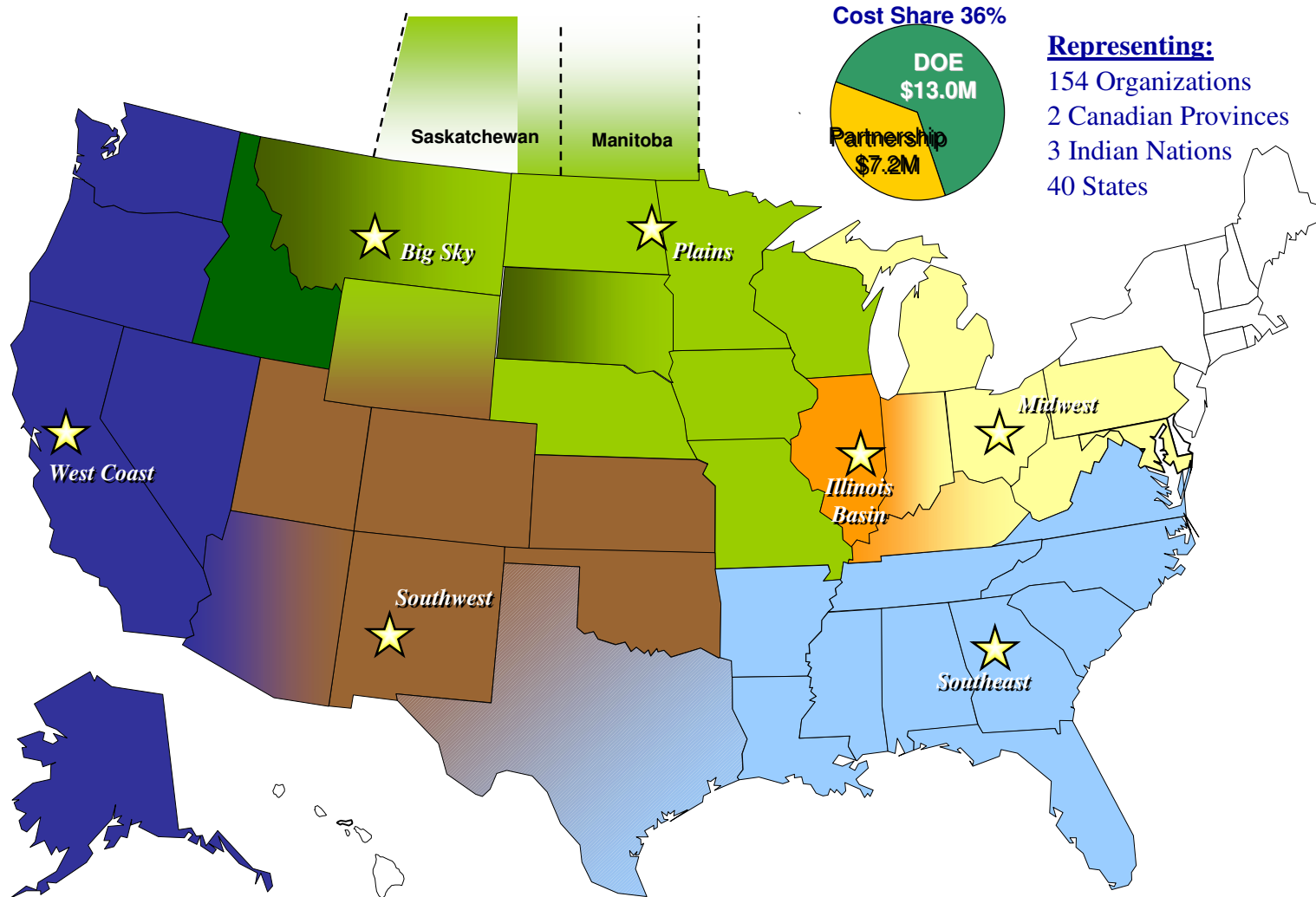


Carbon Sequestration Program Structure



Regional Carbon Sequestration Partnerships

Seven Partnerships Established in Five Geographic Regions



Regional Carbon Sequestration Partnerships

Developing Infrastructure for Wide Scale Deployment

- **Baseline region for sources and sinks**
- **Address regulatory, environmental, outreach issues**
- **Establish monitoring and verification protocols**
- **Validating sequestration technology & infrastructure**
 - Phase 1 - design
 - Phase 2 - testing
- **Determine benefits of sequestration to region**

These partnerships - 4 to 10 across the country, each made up of private industry, universities, and state and local governments - will become the centerpiece of our sequestration program. They will help us determine the technologies, regulations, and infrastructure that are best suited for specific regions of the country.

Energy Secretary Spencer Abraham
November 21, 2002



FutureGen . . .

- Produce electricity and hydrogen from coal using advanced technology
- Emit virtually no air pollutants
- Capture and permanently sequester CO₂

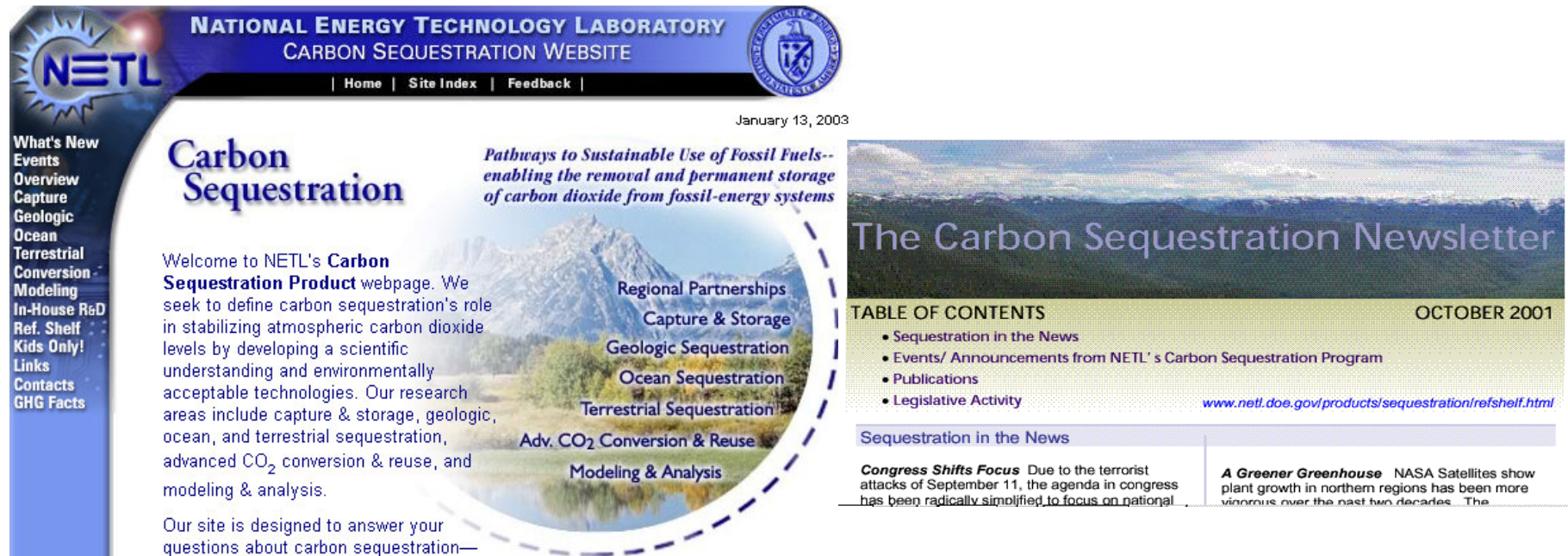
Address three Presidential initiatives:

- FreedomCar
- Clear Skies
- Climate Change



NETL Carbon Sequestration Website & Newsletter

www.netl.doe.gov/coalpower/sequestration/



The screenshot displays the NETL Carbon Sequestration Website and Newsletter. The website header includes the NETL logo, the text "NATIONAL ENERGY TECHNOLOGY LABORATORY CARBON SEQUESTRATION WEBSITE", and navigation links: Home, Site Index, Feedback. A date stamp reads "January 13, 2003". The main content area is titled "Carbon Sequestration" and features a large image of a mountain landscape. Text on the page includes: "Pathways to Sustainable Use of Fossil Fuels-- enabling the removal and permanent storage of carbon dioxide from fossil-energy systems", "Welcome to NETL's Carbon Sequestration Product webpage. We seek to define carbon sequestration's role in stabilizing atmospheric carbon dioxide levels by developing a scientific understanding and environmentally acceptable technologies. Our research areas include capture & storage, geologic, ocean, and terrestrial sequestration, advanced CO₂ conversion & reuse, and modeling & analysis.", "Our site is designed to answer your questions about carbon sequestration—", and a list of topics: Regional Partnerships, Capture & Storage, Geologic Sequestration, Ocean Sequestration, Terrestrial Sequestration, Adv. CO₂ Conversion & Reuse, and Modeling & Analysis. The newsletter section, titled "The Carbon Sequestration Newsletter", includes a "TABLE OF CONTENTS" for "OCTOBER 2001" with items: Sequestration in the News, Events/ Announcements from NETL's Carbon Sequestration Program, Publications, and Legislative Activity. A link is provided: www.netl.doe.gov/products/sequestration/refsheff.html. Below the table of contents, there are two sections: "Sequestration in the News" with the headline "Congress Shifts Focus" and "A Greener Greenhouse" with the headline "NASA Satellites show plant growth in northern regions has been more vigorous over the past two decades".

Subscribe for The Carbon Sequestration Newsletter

Each month, NETL publishes a short newsletter describing significant events related to carbon sequestration that have taken place over the past month. This newsletter is posted here on our website's [Reference Shelf](#) and distributed by e-mail. If you'd like to join the e-mail distribution list, please refer to the [Subscription Directions](#) page for more information as to "Subscribing" and "Unsubscribing" to our mailing list.

